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TITLE OF INVENTION

DUST COLLECTING APPARATUS

FIELD OF THE INVENTION

[0001]

The present invention relates to a dust collecting apparatus provided with a rotary brush at its dust inlet.

BACKGROUND ART

[0002]

Dust collecting apparatuses are generally classified into a manual type which has a floor suction tube held and moved manually for cleaning and a self-running type which has a vehicle driven with an electric motor. Such a manual type of dust collecting apparatus includes a floor suction tube and a base having a dust collecting unit and an electric motor for driving the dust collecting unit and arranged for connection with the floor suction tube, in which a suction air flow is generated by the action of the electric motor in the dust collecting unit and the floor suction tube for absorbing dusts from the floor through the suction opening of the floor suction tube.

[0003]

Some self-running type dust collecting apparatuses are disclosed in Patent Citations 1, 2, and 3. The apparatus disclosed in Patent Citation 1 includes a dust receiving unit provided beneath

a vehicle and equipped with a rotary brush, a first dust collecting unit provided at one side of the dust receiving unit, a second dust collecting unit provided on the vehicle for connection via a connection tube to the first dust collecting unit, a third dust collecting unit for connection via a connection passage to the second dust collecting unit, and an electric motor for conducting an action of collecting dusts, in which when dusts have been taken in the dust receiving unit by the action of the electric motor, large particles, medium particles, and small particles of the dusts are stored in the first dust collecting unit, the second dust collecting unit, and the third dust collecting unit respectively.

[0004]

The apparatus disclosed in Patent Citation 2 includes a dust receiving unit provided beneath a vehicle and equipped with a rotary brush, a dust collecting unit provided on the vehicle for connection via a connection tube to the dust receiving unit, and an electric motor for conducting an action of collecting dusts, in which dusts brushed and collected by the action of the rotary brush are conveyed to the dust conductor unit by intermittently energizing the electric motor.

[0005]

The apparatus disclosed in Patent Citation 3 includes a dust receiving unit provided beneath a vehicle and equipped with a rotary brush, a pickup roller provided at one side of the dust receiving unit, a blower provided on the vehicle for collecting dusts, and a dust

collecting unit provided across a connection passage from the blower and the dust receiving unit, in which the dusts can be collected by the action of the rotary brush and picked up to the dust collecting unit by the action of the pickup roller when the blower, the pickup roller, and the rotary brush are in the rotating action.

Patent Citation 1: JP Patent Publication No. (Heisei) 8-89451.

Patent Citation 2: JP Patent Publication No. 2003-10076.

Patent Citation 3: JP Patent Publication No. (Heisei) 10-317338.

DISCLOSURE OF THE INVENTION

Problems to be solved by the Invention

[0006]

However in the manual type dust collecting apparatus, the distance between the suction opening of the floor suction tube and the base is relatively long, thus requiring a greater level of the suction force and increasing the size of the electric motor for conducting the action of collecting the dusts.

[0007]

The apparatuses disclosed in Patent Citations 1 and 3 allow the electric motor for collecting the dusts to remain energized continuously and thus create a significant magnitude of noise as well as increasing the power consumption, while the action of the electric motor is continued even if the dust receiving unit receives a smaller amount of the dusts hence declining the efficiency of the dust collecting action. Also, the apparatus disclosed in Patent

Citation 2 permits the dusts brushed and collected on the floor by the action of the rotary brush to be conveyed directly to the dust collecting unit with the use of a relatively large size of the electric motor which will hence increase both the noise and the power consumption.

[0008]

The present invention has been developed in view of the foregoing aspects and its object is to provide a dust collecting apparatus which includes a dust collecting unit having a primary chamber for storing dusts collected by the rotating action of a rotary brush and a secondary chamber connecting with the primary chamber via a connection passage and a conveying means for intermittently conveying the dusts from the primary chamber to the secondary chamber, whereby the force necessary for conveying the dusts can be minimized.

[0009]

Another object of the present invention is to provide a dust collecting apparatus wherein the rotary brush is arranged to generate a air flow for conveying the dusts received from the dust receiving unit to the dust collecting unit, whereby the dusts can be conveyed to the dust collecting unit with no use of a large size fan which is commonly employed in a conventional electric cleaner for being continuously driven in order to generate a suction force.

[0010]

A further object of the present invention is to provide a dust

collecting apparatus wherein the rotary brush is surrounded by an intake passage which communicates with the primary chamber and a leak inhibiting wall is provided for inhibiting the air flow generated by the rotating action of the rotary brush from leaking out from the intake passage in a direction of rotation of the rotary brush, whereby the efficiency of collecting the dusts can be improved.

[0011]

A still further object of the present invention is to provide a dust collecting apparatus wherein the intake passage is arranged substantially equal in the width to the rotary brush, whereby the resistance along the intake passage can be lowered and the suction of the dusts can be eased.

[0012]

A still further object of the present invention is to provide a dust collecting apparatus wherein a subsidiary air flow generating means is additionally provided for generating a subsidiary air flow to assist the air flow generated by the rotating action of the rotary brush for conveying the dusts received from the dust receiving unit to the dust collecting unit, whereby the dusts at relatively greater levels of the specific gravity splashed up by the rotary brush can be suctioned with ease.

[0013]

A still further object of the present invention is to provide a dust collecting apparatus wherein the connection passage is arranged flush with or lower than the bottom of the primary

chamber, whereby the force necessary for conveying the dusts from the primary chamber to the secondary chamber can be minimized.

[0014]

A still further object of the present invention is to provide a dust collecting apparatus wherein the bottom of the primary chamber is located higher than the center of rotation of the rotary brush, whereby the connection passage is located at a relatively lower position and the conveying of the dusts from the primary chamber to the secondary chamber can be conducted with the use of a small output electric fan.

[0015]

A still further object of the present invention is to provide a dust collecting apparatus wherein the bottom of the primary chamber is arranged lower at the connection passage side than at its dust collection opening connecting with the intake passage, whereby the force necessary for conveying the dusts from the primary chamber to the secondary chamber can be minimized and even if the dust collecting apparatus is lifted up or during the cleaning action, the dusts in the primary chamber can hardly return back to the dust collection opening.

[0016]

A still further object of the present invention is to provide a dust collecting apparatus wherein the bottom of the primary chamber has a group of ribs provided thereon for guiding the dusts received by the primary chamber to the connection passage while

inhibiting a backward flow to the intake passage, whereby the dusts can easily be conveyed from the primary chamber to the secondary chamber.

[0017]

A still further object of the present invention is to provide a dust collecting apparatus wherein the secondary chamber is arranged greater than the primary chamber, whereby the collected amount of the dusts in the secondary chamber can be increased.

[0018]

A still further object of the present invention is to provide a dust collecting apparatus wherein the secondary chamber is arranged lower at the connection passage side than at the other side opposite to the connection passage, as having a slope thereof inclined from the connection passage side to the other side, whereby the collected amount of the dusts in the secondary chamber can be increased.

[0019]

A still further object of the present invention is to provide a dust collecting apparatus wherein the connection passage is arranged open to the side opposite to the dust collection opening of the primary chamber which communicates with the intake passage and the secondary chamber is located higher at the other side opposite to the connection passage than the primary chamber, whereby the overall size in the plan view of the dust collecting apparatus can be minimized and whereby the air flow generated by

the rotating action of the rotary brush and/or the air flow generated by the subsidiary air flow generating means can be minimized in loss, thus allowing the dusts to be conveyed from the primary chamber to the secondary chamber by a relatively smaller magnitude of the air flow.

[0020]

A still further object of the present invention is to provide a dust collecting apparatus wherein the secondary chamber has a vent opening therein provided at the other side opposite to the connection passage and the conveying means is an electric fan disposed at the outer side of the vent opening, whereby the overall size in the plan view of the dust collecting apparatus can be minimized.

[0021]

A still further object of the present invention is to provide a dust collecting apparatus wherein a means is provided for driving the electric fan automatically and intermittently, whereby the dusts can be conveyed intermittently and certainly from the primary chamber to the secondary chamber without being stalled in the primary chamber.

[0022]

A still further object of the present invention is to provide a dust collecting apparatus wherein a check valve is provided for inhibiting the dusts from returning back from the secondary chamber to the primary chamber, whereby the dusts can be prevented from over-accumulating in the primary chamber.

[0023]

A still further object of the present invention is to provide a dust collecting apparatus wherein the rotary brush is rotatably linked to an electric motor which is located above the rotary brush, whereby the intake passage connecting with the primary chamber can be widened and, still, the overall dimensions of the dust collecting apparatus can be minimized in the plan view.

[0024]

A still further object of the present invention is to provide a dust collecting apparatus wherein a housing is detachably mounted and arranged to define the secondary chamber, whereby the dusts in the secondary chamber can easily be disposed to the outside.

[0025]

A still further object of the present invention is to provide a dust collecting apparatus wherein an operating member having retaining portions thereof for retaining the housing is arranged movable upwardly and downwardly , whereby the housing can easily be detached.

Means for solving the Problems

[0026]

A dust collecting apparatus according to the first feature of the present invention having a dust receiving unit equipped with a rotary brush and a collector unit for collecting dusts received from the dust receiving unit is characterized in that the dust collecting

unit includes a primary chamber for storing the dusts splashed up by the rotating action of the rotary brush and a secondary chamber connecting with the primary chamber via a connection passage and that a conveying means is provided for intermittently conveying the dusts from the primary chamber to the secondary chamber.

[0027]

The first feature of the present invention allows the dusts to be splashed up by the rotary brush, collected in the primary chamber, and conveyed intermittently from the primary chamber to the secondary chamber, whereby the force necessary for conveying the dusts can be minimized and the conveying means can thus be decreased in size with a minimum of the power consumption. Also, the noise generated by the conveying means will be declined.

[0028]

The dust collecting apparatus according to the second feature of the present invention is characterized in that the rotary brush is arranged to generate a air flow for conveying the dusts received from the dust receiving unit to the dust collecting unit.

[0029]

The second feature of the present invention allows the rotating action of the rotary brush to generate a air flow for conveying the dusts received from the dust receiving unit to the dust collecting unit, whereby the dusts can be conveyed to the dust collecting unit with no use of a large size fan which is commonly employed in a conventional electric cleaner for being continuously

driven in order to generate a suction force.

[0030]

The dust collecting apparatus according to the third feature of the present invention, is characterized in that the rotary brush is surrounded by an intake passage which communicates with the primary chamber and a leak inhibiting wall is provided for inhibiting the air flow generated by the rotating action of the rotary brush from leaking out from the intake passage in a direction of rotation of the rotary brush.

[0031]

The third feature of the present invention allows the air flow to be increased in the pressure along the intake passage, whereby the efficiency of collecting the dusts can be improved.

[0032]

The dust collecting apparatus according to the fourth feature of the present invention, is characterized in that the intake passage is arranged substantially equal in width to the rotary brush.

[0033]

The fourth feature of the present invention allows the dusts to be lifted up from the sweeping location by the rotating action of the rotary brush, whereby the resistance along the intake passage can be lowered and the suction of the dusts can be eased.

[0034]

The dust collecting apparatus according to the fifth feature of the present invention, is characterized in that a subsidiary air flow

generating means is additionally provided for generating a subsidiary air flow to assist the air flow generated by the rotating action of the rotary brush for conveying the dusts received from the dust receiving unit to the dust collecting unit.

[0035]

The fifth feature of the present invention allows the air flow which is faster than that generated by the rotating action of the rotary brush to be produced along the intake passage, whereby the dusts at relatively greater levels of the specific gravity splashed up by the rotary brush can be suctioned with ease.

[0036]

The dust collecting apparatus according to the sixth feature of the present invention, is characterized in that the connection passage is arranged flush with or lower than the bottom of the primary chamber.

[0037]

The sixth feature of the present invention allows the resistance during the action of conveying the dusts from the primary chamber to the secondary chamber to be reduced, whereby the force necessary for conveying the dusts from the primary chamber to the secondary chamber can be minimized.

[0038]

The dust collecting apparatus according to the seventh feature of the present invention, is characterized in that it is supported by running wheel and includes a vehicle on which both

the dust receiving unit and the dust collecting unit are mounted and that the bottom of the primary chamber is located higher than the center of rotation of the rotary brush.

[0039]

The seventh feature of the present invention allows an extra space to be provided beneath the primary chamber, whereby the connection passage is located at a relatively lower position and the conveying of the dusts from the primary chamber to the secondary chamber can be conducted with the use of a small output electric fan.

[0040]

The dust collecting apparatus according to the eighth feature of the present invention is characterized in that the bottom of the primary chamber is arranged lower at the connection passage side than at its dust collection opening connecting with the intake passage.

[0041]

The eighth feature of the present invention allows the resistance to be reduced during the movement of the dusts in the primary chamber, whereby the force necessary for conveying the dusts from the primary chamber to the secondary chamber can be minimized hence decreasing the overall size of the conveying means and increasing the freedom of the design. Also, even if the dust collecting apparatus is lifted up or during the cleaning action, the dusts in the primary chamber can hardly return back to the dust collection opening.

[0042]

The dust collecting apparatus according to the ninth feature of the present invention, is characterized in that the bottom of the primary chamber has a group of ribs provided thereon for guiding the dusts received by the primary chamber to the connection passage while inhibiting a backward flow to the intake passage.

[0043]

The ninth feature of the present invention allows the dusts to hardly move back in the primary chamber but be guided along the ribs towards the connection passage, whereby the dusts can easily be conveyed from the primary chamber to the secondary chamber.

[0044]

The dust collecting apparatus according to the tenth feature of the present invention is characterized in that the secondary chamber is arranged greater in size than the primary chamber.

[0045]

The tenth feature of the present invention allows the dusts to be easily conveyed from the primary chamber to the secondary chamber, whereby the collected amount of the dusts in the secondary chamber can be increased and its disposal after the dust collecting action will be conducted in bulk.

[0046]

The dust collecting apparatus according to the eleventh feature of the present invention is characterized in that the secondary chamber is arranged lower at the connection passage side

than at the other side opposite to the connection passage as having a slope thereof inclined from the connection passage side to the other side.

[0047]

The eleventh feature of the present invention allows the dusts at relatively smaller levels of the specific gravity to be easily conveyed from the connection passage side to the other side in the secondary chamber while the dusts at relatively greater levels of the specific gravity remain kept at the connection passage side, whereby the collected amount of the dusts in the secondary chamber can be increased.

[0048]

The dust collecting apparatus according to the twelfth feature of the present invention, is characterized in that the connection passage is arranged open to the side opposite to the dust collection opening of the primary chamber which communicates with the intake passage and the secondary chamber is located higher at the other side opposite to the connection passage than the primary chamber.

[0049]

The twelfth feature of the present invention allows the primary chamber and the secondary chamber to be located upper and lower, whereby the overall size in the plan view of the dust collecting apparatus can be minimized and whereby the air flow generated by the rotating action of the rotary brush and/or the air

flow generated by the subsidiary air flow generating means can be minimized in loss, thus allowing the dusts to be conveyed from the primary chamber to the secondary chamber by a relatively smaller magnitude of the air flow.

[0050]

The dust collecting apparatus according to the thirteenth feature of the present invention is characterized in that the secondary chamber has a vent opening therein provided at the other side opposite to the connection passage and the conveying means is an electric fan disposed at the outer side of the vent opening.

[0051]

The thirteenth feature of the present invention allows both the secondary chamber and the electric fan to be located side by side over the primary chamber, whereby the overall size in the plan view of the dust collecting apparatus can be minimized.

[0052]

The dust collecting apparatus according to the fourteenth feature of the present invention is characterized in that a means is provided for driving the electric fan automatically and intermittently.

[0053]

The fourteenth feature of the present invention allows the dusts to be conveyed intermittently and certainly from the primary chamber to the secondary chamber without being stalled in the primary chamber.

[0054]

The dust collecting apparatus according to the fifteenth feature of the present invention is characterized in that a check valve is provided for inhibiting the dusts from returning back from the secondary chamber to the primary chamber.

[0055]

The fifteenth feature of the present invention allows the dusts to be prevented from over-accumulating in the primary chamber while being conveyed smoothly from the primary chamber to the secondary chamber without being stalled in the connection passage.

[0056]

The dust collecting apparatus according to the sixteenth feature of the present invention is characterized in that the rotary brush is rotatably linked to an electric motor which is located above the rotary brush.

[0057]

The sixteenth feature of the present invention allows the primary chamber to be sized corresponding to the length along the axial direction of the rotary brush and located between the rotary brush and the electric motor, whereby the intake passage connecting with the primary chamber can be widened and minimized in the resistance of the dusts to be conveyed and, still, the primary chamber can be positioned without being disturbed by the electric motor and the overall dimensions of the dust collecting apparatus

can be minimized in the plan view.

[0058]

The dust collecting apparatus according to the seventeenth feature of the present invention is characterized in that a housing is provided for being detachably mounted and arranged to define the secondary chamber.

[0059]

The seventeenth feature of the present invention allows the housing to be easily detached, whereby the dusts in the secondary chamber can easily be disposed to the outside.

[0060]

The dust collecting apparatus according to the eighteenth feature of the present invention is characterized in that an operating member arranged movable upwardly and downwardly and having retaining portions thereof for retaining the housing is provided.

[0061]

The eighteenth feature of the present invention allows the operating member to be pressed down for disengaging the housing from the dust collecting apparatus which remains on the floor, whereby the housing can easily be detached.

[0063]

According to the first feature of the present invention, the force necessary for conveying the dusts can be minimized while the conveying means is thus decreased in size with a minimum of the power consumption. Also, the noise generated by the conveying

means can be reduced.

[0063]

According to the second feature of the present invention, the dusts can be conveyed to the dust collecting unit with no use of a large size fan which is commonly employed in a conventional electric cleaner for being continuously driven in order to generate a suction force.

[0064]

According to the third feature of the present invention, the efficiency of collecting the dusts can be improved since the air flow is increased in pressure along the intake passage.

[0065]

According to the fourth feature of the present invention, the resistance along the intake passage can be lowered and the suction of the dusts can be eased.

[0066]

According to the fifth feature of the present invention, the dusts at relatively greater levels of the specific gravity splashed up by the rotary brush can be suctioned with ease.

[0067]

According to the sixth and eighth features of the present invention, the force necessary for conveying the dusts from the primary chamber to the secondary chamber can be minimized, hence further decreasing the overall size of the conveying means. Also, when the dust collecting apparatus is lifted up or during the

cleaning action, the dusts can hardly be moved back to the dust collection opening side of the primary chamber.

[0068]

According to the seventh feature of the present invention, with the connection passage located at a relatively lower position, the conveying of the dusts from the primary chamber to the secondary chamber can be conducted with the use of a small output electric fan.

[0069]

According to the ninth feature of the present invention, the dusts can easily be conveyed from the primary chamber to the secondary chamber.

[0070]

According to the tenth feature of the present invention, the collected amount of the dusts in the secondary chamber can be increased and its disposal after the dust collecting action will be conducted in bulk.

[0071]

According to the eleventh feature of the present invention, the dusts at relatively smaller levels of the specific gravity can easily be conveyed from the connection passage side to the other side in the secondary chamber while the dusts at relatively greater levels of the specific gravity remain kept at the connection passage side and hence the collected amount of the dusts in the secondary chamber can be increased.

[0072]

According to the twelfth feature of the present invention, with the primary chamber and the secondary chamber located upper and lower, the overall size in the plan view of the dust collecting apparatus can be minimized and also, the air flow generated by the rotating action of the rotary brush and/or the air flow generated by the subsidiary air flow generating means can be minimized in loss, thus allowing the dusts to be conveyed from the primary chamber to the secondary chamber by a relatively smaller magnitude of the air flow.

[0073]

According to the thirteenth feature of the present invention, with both the secondary chamber and the electric fan located side by side over the primary chamber, the overall size in the plan view of the dust collecting apparatus can be minimized.

[0074]

According to the fourteenth feature of the present invention, the dusts can be conveyed intermittently and certainly from the primary chamber to the secondary chamber without being stalled in the primary chamber.

[0075]

According to the fifteenth feature of the present invention, the dusts can be prevented from over-accumulating in the primary chamber while being conveyed smoothly from the primary chamber to the secondary chamber without being stalled in the connection

passage.

[0076]

According to the sixteenth feature of the present invention, the intake passage connecting with the primary chamber can be minimized in the resistance of the dusts to be conveyed and simultaneously the overall dimensions of the dust collecting apparatus can be minimized in the plan view.

[0077]

According to the seventeenth feature of the present invention, the housing can easily be detached, hence permitting the dusts in the secondary chamber to be easily disposed to the outside.

[0078]

According to the eighteenth feature of the present invention, the operating member can be pressed down for disengaging the housing from the dust collecting apparatus which remains on the floor, hence permitting the dusts in the secondary chamber to be more easily disposed to the outside.

BRIEF DESCRIPTION OF THE DRAWINGS

[0079]

Fig. 1 is a perspective view of a dust collecting apparatus according to the present invention showing the arrangement of Embodiment 1;

Fig. 2 is a perspective view of the same where the secondary chamber is removed from a dust collecting unit;

Fig. 3 is an enlarged cross sectional view taken along the line III-III of Fig. 1;

Fig. 4 is an enlarged cross sectional view taken along the line IV-IV of Fig. 1;

Fig. 5 is an enlarged cross sectional view taken along the line V-V of Fig. 1;

Fig. 6 is an enlarged cross sectional view taken along the line VI-VI of Fig. 1;

Fig. 7 is a plan view of the same having some parts removed;

Fig. 8 is a plan view of an arrangement of the dust collecting unit;

Fig. 9 is a back view of the dust collecting apparatus showing Embodiment 1 of the present invention;

Fig. 10 is a side view of the dust collecting apparatus showing Embodiment 1 of the present invention;

Fig. 11 is a transverse plan view of a dust collecting apparatus showing Embodiment 2 of the present invention;

Fig. 12 is a longitudinally cross sectional view showing a primary part of the dust collecting apparatus according to Embodiment 2 of the present invention;

Fig. 13 is a transverse plan view showing a primary part of the dust collecting apparatus according to Embodiment 2 of the present invention;

Fig. 14 is a longitudinally cross sectional view showing a primary part of the dust collecting apparatus according to

Embodiment 2 of the present invention;

Fig. 15 is a plan view of the dust collecting apparatus according to Embodiment 2 of the present invention where some regions are eliminated; and

Fig. 16 is a schematic perspective view showing the primary part of the dust collecting apparatus according to Embodiment 2 of the present invention.

DESCRIPTION OF THE NUMERALS

[0080]

3. Rotary brush

4. Dust receiving unit

41. Intake passage

42. Leak inhibiting wall

5. Dust collecting unit

51. Primary chamber

51a. Dust collection opening

51d. Bottom

51e. Ribs,

52. Connection passage

53. Secondary chamber

53b. Slope

53d. Vent opening

56. Check valve

57. Connection passage

57a. Opening

58. Housing

6. Electric motor

9. Electric fan (conveying means)

11. Operating member

11d. Engaging holes (engaging means).

BEST MODES FOR CARRYING OUT THE INVENTION

[0081]

The present invention will be described in more detail referring to the relevant drawings of its embodiments.

Embodiment 1

[0082]

Fig. 1 is a perspective view showing an arrangement of the dust collecting apparatus according to the present invention, Fig. 2 is a perspective view showing a secondary chamber of its dust collecting unit removed off, Fig. 3 is an enlarged cross sectional view taken along the line III-III of Fig. 1, Fig. 4 is an enlarged cross sectional view taken along the line IV-IV of Fig. 1, Fig. 5 is an enlarged cross sectional view taken along the line V-V of Fig. 1, Fig. 6 is an enlarged cross sectional view taken along the line VI-VI of Fig. 1, Fig. 7 is a plan view showing a part removed off, Fig. 8 is a plan view showing an arrangement of the dust collecting unit, Fig. 9 is a back view of the arrangement of Embodiment 1, and Fig. 10 is a

side view showing the arrangement of Embodiment 1.

[0083]

The dust collecting apparatus shown in Fig. 1 is a self-running type cleaning robot which comprises a vehicle 2 supported by a group of running wheels 1, a dust receiving unit 4 having a rotary brush 3 rotatably supported by the vehicle 2, a dust collecting unit 5 provided above the rotary brush 3 for collecting dusts taken in from the dust receiving unit 4, an electric motor 6 provided above a region of the dust collecting unit 5 for driving the brush, and an electric motor (not shown) for driving the running wheels. The rotary brush 3 is provided for generating a air flow to convey the dusts received from the dust receiving unit 4 to the dust collecting unit 5. In the preset invention, since the air flow is generated by the rotary brush 3 for conveying the dusts from the dust receiving unit 4 to the dust collecting unit 5, it allows the dusts to be received by the dust collecting unit 5 with no use of any large size fan provided in a common electric vacuum cleaner for normally being driven to generate a force of suction.

[0084]

The dust collecting apparatus according to the present invention is entirely arranged of a flat, substantially circular shape and Fig. 1 illustrates a rear half of the dust collector apparatus. As shown in Fig. 1, the rightward direction is a running direction and the dust receiving unit 4 is located adjacent to and rearwardly of the running wheels 1 along the running direction. As the dust

receiving unit 4 is at the proximity of the running wheels 1, its width can be increased enough to minimize the remaining of dusts during the cleaning action of the dust collector apparatus.

[0085]

The dust receiving unit 4 includes the rotary brush 3 arranged horizontally on the lower side of the vehicle 2, a dust intake passage 41 communicated from the circumferential side of the rotary brush 3 to the primary chamber of the dust collecting unit 5, which will be explained later, for directing the air flow generated by the rotating action of the rotary brush 3 into the primary chamber, a leak inhibiting wall 42 disposed at a very small distance from the circumferential side of the rotary brush 3 for inhibiting the air flow from leaking out from the intake passage 41 as moving in the rotating direction of the rotary brush 3, and a swirl inhibiting member 44 provided to extend downwardly from the leak inhibiting wall 42 for inhibiting the outside air from swirling in. The intake passage 41 is defined by an arcuate wall 43 which is disposed at a relatively greater distance from the circumferential side of the rotary brush 3 and arranged substantially equal in the width to the rotary brush 3. The trailing end of the intake passage 41 extends from the upper end of the rotary brush 3 in parallel to the axial center of the rotary brush 3. Also, the intake passage 41 and the swirl inhibiting member 44 are so sized as to correspond to the width of the rotary brush 3. The swirl inhibiting member 44 is located at the proximity of the rotary brush 3 to extend in a reverse of the

running direction of the vehicle 2 from the rotary brush 3 to a length for coming into substantially direct contact with the floor, whereby, when the rotary brush 3 rotates, the outside air can be inhibited from swirling in between the dust receiving unit 4 and the floor to blow up dusts on the floor along the running direction.

[0086]

The rotary brush 3 has a set of bristles or rubber blades mounted to the peripheral side of an axial body thereof made of a light metal material such as aluminum and is horizontally supported at both ends by a pair of roller bearings 7 and 7 on the vehicle 2. The rotary brush 3 is linked at one end via a transmission belt 8 to the output shaft of the electric motor 6 for rotation in a reverse of the rotating direction of the running wheels 1 or, in other words, in a reverse of the running direction of the vehicle 2.

[0087]

The dust collecting unit 5 is arranged of a flat shape extending in parallel to the axial center of the rotary brush 3 and includes the primary chamber 51 provided for storage of the dusts collected by the rotating action of the rotary brush 3 and a secondary chamber 53 connecting via a connection passage 52 with the primary chamber 51 as adapted greater in size than the primary chamber 51, whereby the air flow for running from the primary chamber 51 to the secondary chamber 53 can be generated by a power fan 9 disposed outwardly of the secondary chamber 53. The primary chamber 51

has a length corresponding to the rotary brush 3 and is defined by a first housing 54 which is arranged of a flat shape having a dust collection opening 51a connecting with the intake passage 41 and an arcuate wall 51b extending between both ends of the dust collection opening 51a, the arcuate wall 51b having an opening 52a provided in one circumferential end thereof for connection with the connection passage 52. As the primary chamber 51 is positioned to be substantially equal in height to the upper side of the rotary brush 3, its dust collection opening 51a is communicated with the trailing end 41a of the intake passage 41. The primary chamber 51 is arranged higher at the bottom than at the rotation center of the rotary brush 3. The bottom 51d of the primary chamber 51 is lower at the opening 52a of the connection passage 52 than at the dust collection opening 51a. The bottom 51d also has a number of arcuately extending ribs 51e provided at equal intervals thereon. The ribs 51e are so shaped that the dusts collected in the primary chamber 51 are advanced towards the connection passage 52 while being prevented from moving back to the intake passage 41 and its height is comparatively low. The connection passage 52 is arranged flush with or lower than the bottom 51d of the primary chamber 51.

[0088]

The secondary chamber 53 has a lower bottom 53a thereof located lower than an opening 52b opposite to the opening 52a and a higher bottom 53c thereof located higher than the lower bottom 53a and the opening 52b and connecting by a slope 53b with the lower

bottom 53a and is defined by a second housing 55 which is arranged of substantially a 1/4 circular shape in the plan view, where the lower bottom 53a (at the opening 52b side) is at one side of the opening 52a of the primary chamber 51 while the higher bottom 53c (at the side opposite to the connection passage 52) is above the primary chamber 51. The lower bottom 53a is arranged of substantially an L shape in the plan view having a connection opening 52b provided at one leg thereof and the slope 53b provided at the other leg thereof. The higher bottom 53c has a vent opening 53d provided in the side opposite to the connection passage thereof to extend from the outside to the side opposite to the connection passage.

[0089]

A check valve 56 for inhibiting the dusts from moving back from the secondary chamber 53 via the connection passage 52 to the primary chamber 51 is provided at the lower bottom 53a of the secondary chamber 53. The check valve 56 remains urged by a relatively smaller force in a direction for shutting up the connection passage 52 and is arranged for being opened by the action of a air flow generated by the electric fan 9. Also, both the first housing 54 and the second housing 55 are arranged detachable.

[0090]

The electric fan 9 is located above the side opposite to the connection passage of the primary chamber 51 and at one side of the secondary chamber 53 while a filter 10 is provided between the

electric fan 9 and the vent opening 53d of the secondary chamber 53 for absorbing the air from the secondary chamber 53 through the action of the electric fan 9 to produce a air flow for conveying the dusts from the primary chamber 51 to the secondary chamber 53. The electric fan 9 is a turbo fan driven intermittently as a conveying means for conveying intermittently the dusts from the primary chamber 51 to the secondary chamber 53.

[0091]

The self-running type dust collecting apparatus having the foregoing arrangement is hence operable with its vehicle 2 running and its rotary brush 3 rotated in a reverse of the running direction of the vehicle 2. As the rotary brush 3 is rotated, it produces a air flow across the intake passage 41 thus to sweep up the dusts from the floor. Sweeping up and the air flow produced by the rotary brush 3 convey the dusts from the intake passage 41 directly to the primary passage 51. More particularly, while the dusts at relatively smaller levels of the specific gravity are absorbed by the air flow, those at relatively greater levels of the specific gravity are brushed by the rotating action of the rotary brush 3, thus increasing the efficiency of cleaning. Also, as the leak inhibiting wall 42 is spaced by a very small distance from the circumferential side of the rotary brush 3, its boundary 42a to the intake passage 41 allows the dusts to be removed from the circumferential side of the rotary brush 3, thus reducing the accumulation of dusts.

[0092]

At the beginning of the cleaning action, the electric fan 9 remains not energized and the dusts received from the intake passage 41 is temporarily stored in the primary chamber 51. After a predetermined length of time, the electric fan 9 starts being driven thus to generate a flow of conveying air from the primary chamber 51 to the secondary chamber 53 by which the dusts stored temporarily in the primary chamber 51 are conveyed from the connection passage 52 to the secondary chamber 53. Since the lower bottom 53a at the opening 52b of the connection passage 52 is connected by the slope 53b to the higher bottom 53c of the secondary chamber 53, the dusts at relatively smaller levels of the specific gravity can easily be moved from the connection passage 52 to the opposite connection passage side while the dusts at relatively greater levels of the specific gravity remain stored in the connection passage side of the secondary chamber 53. As the bottom of the primary chamber 51 is arranged higher than the rotation center of the rotary brush 3, there is more space available beneath the primary chamber 51. This permits the connection passage 52 to be located lower, whereby the dusts can be moved from the primary chamber 51 to the secondary chamber 52 with the use of a small output type of the electric fan 9. After a predetermined period of time, the electric fan 9 is turned off but the rotary brush 3 remains rotating during both the activated and deactivated periods of the electric fan 9 thus allowing the dusts received from the intake unit 4 to be stored in the primary chamber 51. The electric fan 9 may be

turned on and off by manually pressing a switch or automatically activating at predetermined intervals of time. In the latter case, for example, the period of deactivating the electric fan 9 and the period of activating the electric fan 9 are measured by a time measuring means installed in a controller which comprises a microprocessor, so that the action of the electric fan 9 can automatically be controlled with a command signal released from the controller. Moreover, a subsidiary air flow generating means such as a small power fan driven constantly may be provided for assisting the air flow produced by the rotary brush 3 conveying the dusts. The subsidiary air flow generating means is located between the electric fan 9 and the secondary chamber 53 or across the intake passage 41, for example. The subsidiary air flow generating means such as a small power fan may be replaced by a specific action of the electric fan 9 remaining activated constantly at lower power and driven at higher power from time to time for quickly conveying the dusts stored in the primary chamber 51 to the secondary chamber 52.

Embodiment 2

[0093]

Fig. 11 is a transverse cross sectional view showing a dust collecting apparatus according to Embodiment 2 of the present invention, Fig. 12 is a longitudinal cross sectional view of a primary part of the same, Fig. 13 is a transverse cross sectional view of the

primary part of the same, Fig. 14 is a longitudinal cross sectional view of a primary part of the same, Fig. 15 is a plan view of the same omitting partially, and Fig. 16 is a schematic perspective view of the primary part of the same.

[0094]

The dust collecting apparatus of this embodiment is fundamentally identical in the arrangement to that of Embodiment 1 but differentiated by the fact that the primary chamber 51 communicates at the side opposite with the dust collection opening 51a along the lengthwise direction to a connection passage 57 which replaces the connection passage 52 provided at the dust collection opening side of the primary chamber 51 while the housing 53 of the secondary chamber 53 is arranged detachable and retained by an operating member 11.

[0095]

The primary chamber 51 has a length corresponding to the rotary brush 3 and is defined by a first housing 54 which is arranged of a flat shape having a dust collection opening 51a connecting with the intake passage 41 and an arcuate wall 51b extending between both ends of the dust collection opening 51a, the arcuate wall 51b having an opening 57a provided in the circumferential center thereof at the side opposite to the dust collection opening 51a for connection with the connection passage 57. The bottom of the primary chamber 51 is arranged lower at the connection passage 57 side than at the dust collection opening 51a side as its dust collection

opening 51a side curves upwardly.

[0096]

The secondary chamber 53 is defined by a housing 58 which has a fan-like shape in the plan view or, in other words, substantially a 1/4 circular shape and is detachably mounted to the upper side at one lengthwise side of the primary chamber 51. The housing 58 has a lower extending portion 58a provided integrally on the bottom thereof which has a cavity as connection passage 57 and an air flow guide 12 is detachably installed in the lower extending portion 58a. The housing 58 also has a vent opening 53d provided in one side thereof, a pair of engaging claws 58b and 58b inside projected in the position spaced laterally, and a holding frame 58c protruded thereon between the two engaging claws 58b and 58b to accommodate an urging member 13 in.

[0097]

The housing 58 has an opening 58d provided in an inner side of the lower extending portion 58a thereof to communicate with the opening 57a of the connection passage 57 and its lower extending portion 58a has a slope 58e provided to tilt from the bottom of the secondary chamber 53 towards one side opposite to the side where the opening 58d and the vent opening 53d are located.

[0098]

The air flow guide 12 covers entirely the upper side of the lower extending portion 58a for guiding the dusts received from the primary chamber 51 to the one side opposite to the side where the

opening 58d and the vent opening 53d are located as is composed of an upper wall 12a facing the slope 58e, a side wall 12b connected with the upper wall 12a, and an engaging portion 12c which is fitted into the lower extending portion 58a, whereby the dusts received from the opening 57a can be conveyed to the secondary chamber 53 along the connection passage 57 between the slope 58e of the lower extending portion 58a and the upper wall 12a of the guide 12.

[0099]

The urging member 13 is arranged to urge housing 58 in a detaching direction to the vehicle 2, and when its engagement by the operating member 11 has been released, to automatically move the housing 18 in a detaching direction. It is accommodated in a shifter member 14 which has a hat-like shape in the cross section and remains held in the holding frame 58c where it can transversely be moved.

[0100]

The operating member 11 is mounted to the vehicle 2 for upward and downward movements an remains urged upwardly by an urging spring 15. The operating member 11 comprises a head portion 11a having an arcuate sheet form in the plan view, a square shaft portion 11c having a pin hole 11b provided therein, and a pair of leg portions 11e and 11e extending from both sides of the lower end of the square shaft portion 11c, each leg portion 11e having an engaging hole 11d provided therein for engagement with the engaging claw 58b, whereby the operating member 11 is movably

mounted to the vehicle 2 by a pin 16 inserted into the pin hole 11b in the square shaft portion 11c. The leg portions 11e and 11e are slidably movable along the vertical in the holding frame 58c at a square shape of the housing 58 so that the jerky movement of the operating member 11 against both the vehicle 2 and the housing 58 will be eliminated. As the urging spring 15 is provided between the head portion 11a and the vehicle 2, its yielding force urges the operating member 11 upwardly thus to ensure the engagement between the engaging claws 58b and 58b and their corresponding engaging holes 11d and 11d.

[0101]

The dust collecting apparatus of this embodiment having the foregoing arrangement is hence equal in the function to that of Embodiment 1 and will be explained in no more detail. In brief, the dusts conveyed from the intake passage 41 to the primary chamber 51 by the sweeping action of the rotary brush 3 and the air flow generated by the rotating action of the rotary brush 3 can be received by the opening 57a of the connection passage 57 and further conveyed along the slope 58e of the connection passage 57 in the air flow guide 12 to the secondary chamber 53. Since the primary chamber 51 curves upwardly at the dust collection opening 51a side and its bottom becomes lower at the connection passage 57 side than the duct collection opening 51a, the dusts can hardly return back from the primary chamber 51 to the intake passage 41 during the cleaning action or even if the dust collecting apparatus is lifted up.

Also, the opening 57a of the connection passage 57 is communicated through at the side opposite to the dust collection opening 51a of the primary chamber 51 and can minimize the loss of the air flow generated by the action of the rotary brush 3 hence allowing the dusts to be conveyed from the primary chamber 51 to the secondary chamber 53 by the air flow at relatively smaller magnitudes. In addition, since the connection passage 57 between the primary chamber 51 and the secondary chamber 53 slopes down towards the bottom of the secondary chamber 53, the air flow required for conveying the dusts from the primary chamber 51 to the secondary chamber 53 can be minimized in the magnitude. Moreover, the upper end of the connection passage 57 connecting between the primary chamber 51 at the lower side and the secondary chamber 53 at the upper side is shut up with the air flow guide 12 and can thus inhibit the dusts received by the secondary chamber 53 from dropping down to or returning back along the connection passage 57. [0102]

For disposing the dusts received by the secondary chamber 53, the housing 58 is removed by pressing down the head portion 11a of the operating member 11 before its secondary chamber 53 can be exhausted with ease. When its head portion 11a is pressed down, the operating member 11 moves downwardly as resisting against the yielding force of the urging spring 15 until the engagement between their engaging holes 11d and 11d and the corresponding engaging claws 58b and 58b is canceled thus to shift the housing 58 in the

direction of detaching due to the yielding force of the urging member 13. Accordingly, when the dust collecting apparatus is placed on the floor, its housing 58 can easily be detached. Also, after the dusts are disposed from the secondary chamber 53, the housing 58 is joined back at the lower extending portion 58a with the vehicle 2 and its engaging claws 58b and 58b are then engaged with their corresponding engaging holes 11d and 11d by the head portion 11a of the operating member 11 being pressed down. This is followed by the operating member 11 being lifted up by the yielding force of the urging spring 15, thus ensuring the engagement between the engaging claws 58b and 58b and the engaging holes 11d and 11d as well as the attachment of the housing 58.

[0103]

While its embodiments are described in the form of a self-running type dust collecting apparatus, the present invention may be implemented by a manually operating type of the dust collecting apparatus.

INDUSTRIAL APPLICABILITY

[0104]

The present invention is applicable to any cleaning robot which includes sensors for detecting obstacles and a controller for controlling the action of running wheels in order to automatically sweep at the inside and the outside.